A NOTE ON THE OCCURRENCE OF SEEDLING LESIONS CAUSED BY CEREAL SMUTS.

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(Plate v.)

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Introduction.

The cereal smuts annually cause heavy losses in Australia. Losses due to flag smut caused by *Urocystis tritici* (Koern.) have been estimated to amount to approximately £400,000 per annum.*

In Australia, preventive measures are not only costly, but often ineffective. The development of immune or resistant varieties offers the most promising solution of the problem. In such work, the determination of resistance or susceptibility in the seedling stages is of great practical value to the plant breeder.

Angell† has shown that, under certain conditions, wheat seedlings become distorted when infected by *Urocystis tritici*. Dr. W. L. Waterhouse, of the Sydney University, and the writer repeated the experiments and obtained additional information relating to infection of seedlings by certain cereal smuts. The results are recorded here.

Methods and Results.

Flag Smut.

The methods described by Angell were closely followed. Four varieties of wheat, viz., Federation, Dundee, Nabawa, and Hope, were heavily inoculated with spores of flag smut which had been presoaked in water for three days. The grain was sown half an inch deep in 4-inch pots in a sterilized loam soil moistened to 40% of its moisture holding capacity, and maintained at a temperature of 20°C. in a dark cellar. The control plants were inoculated with a suspension of spores previously killed by boiling.

An examination of the plants ten days after sowing showed some distortion of all varieties which had been inoculated. But, what was more striking, white opaque patches, varying in size from minute spots to areas 0·5 × 1·5 cm., were observed on the coleoptile and leaves of inoculated plants (Plate v, figs. 1–4). Occasionally spots became confluent, producing a continuous white patch along the entire length of the coleoptile, which, because of the swellings accompanying the spots, often assumed an irregular or blistered appearance.

A microscopic examination of stained sections cut through these spots showed the presence of the smut fungus (Plate v, figs. 5–6). Two very distinct types of mycelium were seen in different parts of the plant tissue. The first,

* Seventh Ann. Report of Council Sci. and Indust. Research, 1933.

† *Journ. Council Sci. Indust. Research*, 7, 1934, 110-112.

which was deeply stained and associated with the vascular tissue, was more abundant and more easily discernible than the second type, which did not stain so deeply. Further, the latter, which apparently originates from the first, grew out towards the periphery at right angles to the length of the coleoptile. The nuclei of the deeply stained mycelium were in the dikaryophase, but none was seen in the second type.

These white spots were produced also on seedlings which had not been confined to darkness during the first ten days of their growth. Light, however, in causing an elongation of the coleoptile made the infection spots more easily discernible and provided a greater area over which the fungus could operate.

The spots appeared on the resistant varieties, Hope, Nabawa, Dundee, as abundantly as on Federation, which is notably susceptible.

Bunt.

Sterilized grain of four varieties of wheat, Federation, Canberra, Nabawa and Florence, was heavily inoculated with a known physiologic form of *Tilletia tritici* (Bjerk.) Winter, which causes bunt of wheat, and grown under the same conditions as described for flag smut.

No distortion occurred; in fact, the inoculated seedlings showed more vigorous growth than the controls, appearing to be stimulated by the presence of the smut. White opaque spots occurred on several plants of Canberra and Federation. Examination of stained sections of these spots showed the presence of a smut mycelium very similar in appearance to that of flag smut.

Grain of the same varieties, inoculated with a mixture of bunt and flag smut, germinated poorly, and the seedlings, which were distorted, were heavily covered with white opaque spots.

Oat Smut.

Two varieties of Oats, Fulghum and Algerian, were dehulled and the grain inoculated with spores of *Ustilago avenae* (Pers.) Jens., which causes the loose smut of oats. These were sown and germinated under the conditions described above. The inoculated pots of Algerian oats showed striking distortion (Plate v, fig. 4) with white opaque spots. Microscopic examination of sections through these showed the presence of smut mycelium. Distortion was not so striking in Fulghum, but the germination was poorer and the growth of the plants less vigorous.

Summary and Conclusions.

Grain of reputedly resistant and susceptible varieties of wheat and oats was inoculated with spores of several cereal smuts and grown under conditions approximating to those set down by Angell. Well defined white opaque spots developed on the coleoptile and first leaf of resistant and susceptible varieties alike, and, in the case of Algerian oats infected by loose smut, distortion was also very marked. An examination of stained microscopic sections through these spots showed the presence of an abundance of smut mycelium of two kinds. The nuclei, which were seen only in the deeply stained mycelium, were in the dikaryophase.

The advantages of being able to detect resistance or susceptibility in the seedling stage are obvious. Under the conditions of the present experiment, white infection spots occurred on both resistant and susceptible varieties, and therefore this symptom, like the distortion of seedlings described by Angell,

cannot be used as a criterion of resistance or susceptibility. These white leprous spots, however, are better indicators of infection than the reported distortion, for, while all the plants in several varieties were spotted, by no means were all distorted.

It is probable that conditions may be found under which field-resistant varieties will not show these infection spots in the seedling stage, having prevented the establishment of the fungus in their tissues. Under the same conditions susceptible varieties may become infected.

There may be, also, further factors for resistance which operate later in the development of the plant. Further experiments on the nature of resistance to cereal smuts are in progress.

Acknowledgment.

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EXPLANATION OF PLATE V.

1.—The wheat seedling leaves showing white infection spots caused by *Urocystis tritici*. × $\frac{3}{4}$.

2, 3.—White opaque infection spots caused by *Urocystis tritici* on the coleoptile of wheat seedlings. 2, × $1\frac{1}{2}$; 3, × $\frac{3}{4}$.

4.—Distorted plants of Algerian oats showing white opaque infection spots caused by *Ustilago avenae*.

5, 6.—Photomicrograph of sections through infection spots on 5, coleoptile; and 6, the leaf of wheat seedlings showing smut mycelium. × 600.